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ERDEC-TR-023

SUMMARY OF UNITED STATES OF AMERICA TREATY VERIFICATION RESEARCH AND DEVELOPMENT PROGRAM

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February 1993

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Work Sponsored by
Defense Nuclear Agency
and Department of Energy

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
1993 February

3. REPORT TYPE AND DATES COVERED
Final, 92 Sep - 92 Sep

4. TITLE AND SUBTITLE
Summary of United States of America Treaty Verification Research and Development Program

5. FUNDING NUMBERS
DNA Project # TA,
Task # TC,
Work Unit # 0001
MIPR # 92-613

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
DIR, ERDEC,* ATTN: SCBRD-ENO-T, APG, MD 21010-5423
SNL, P.O. Box 5800, Albuquerque, NM 87185

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDEC-TR-023

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
DIR, DNA, 6801 Telegraph Road, Alexandria, VA 22310-3398
DIR, DOE, 1000 Independence Ave., S.W.
Washington, DC 20585

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES *When this work was performed, ERDEC was known as the U.S. Army Chemical Research, Development and Engineering Center, and the author was assigned to the Munitions Directorate.
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12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
Since 1989, the United States has pursued a Treaty Verification Research and Development Program relating to the objectives of the Chemical Weapons Convention. This report provides a summary of the United States program, a compilation of results relating to inspection activities, personnel, equipment and capability gaps, and a listing of relevant United States reports. Because the United States Treaty Verification Research and Development Program is ongoing, the results and suggestions offered here should be viewed as a current status report, which may change with future research.

14. SUBJECT TERMS
Challenge inspection
Inspection equipment
Inspection procedures
Chemical Weapons Convention

15. NUMBER OF PAGES
39

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

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PREFACE

The work described in this report was sponsored by the Defense Nuclear Agency under Project No. TA, Task No. TC, and Work Unit No. 0001. This work was started and completed in September 1992.

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Acknowledgments

The authors are indebted to the following individuals who assisted in the preparation and review of this document: Dr. C. Ruth Kempf (Brookhaven National Laboratory, Upton, NY); William Dee, Joseph Lovrich, Kevin Duvall, Mark Jefferies, James Hertzog, Herman Hildebrandt, Alan Goodman, Jerry Hawks (ERDEC); Dr. William Stanbro (Los Alamos National Laboratory, Los Alamos, NM); Dr. Raymond McGuire (Lawrence Livermore National Laboratory, Livermore, CA); LTC Classen Wyckoff (On-Site Inspection Agency, Washington, DC); Dr. Alan Zelicoff, Michael Vannoni (Sandia National Laboratories, Albuquerque. NM); Dr. Leo Zeftel (private consultant); and MG John Stoner (RET) (EAI Corporation, Abingdon, MD).

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SUMMARY OF UNITED STATES OF AMERICA TREATY VERIFICATION RESEARCH AND DEVELOPMENT PROGRAM

Since 1989 the United States has pursued a Treaty Verification Research and Development Program relating to the objectives of the Chemical Weapons Convention (CWC). In an effort to share information resulting from this initiative, the following general information is provided. Included is a summary of the U.S. program, a compilation of results relating to inspection activities, personnel, equipment and capability gaps, and a listing of relevant United States reports. As the United States program is ongoing, the observations discussed here should be viewed as a current status report which may change with future research.

I. SUMMARY OF UNITED STATES TREATY VERIFICATION RESEARCH AND DEVELOPMENT PROGRAM

The U.S. research and development program on CW treaty verification was initiated in 1989 and is comprised of three integrated components:

- National Trial Inspections (NTI).
- Investigation of on-site inspection procedures, equipment and supporting technologies.
- Technology development programs.

NTIs are conducted primarily to evaluate policy options. Investigation of on-site inspection provides a baseline of procedures and existing equipment for the conduct of CWC inspections. This later effort identifies verification technology gaps which are addressed by the technology development programs. The three components to the U.S. program are summarized below:

A. National Trial Inspections. The U.S. has conducted the following NTIs:

NTI-1: Routine inspection of a commercial Schedule 2 facility - February 1989, Akzo Chemicals Inc., Gallipolis Ferry, W. VA.[1]

NTI-2: Routine inspection of a commercial Schedule 2 facility - March 1990, Alcolac, Inc., Baltimore, MD[2]

NTI-3: Challenge inspection (commercial chemical industry) - September 1990, Monsanto Agricultural Company, Luling, LA[3]

NTI-4: Challenge inspection (U.S. Army Arsenal) - January 1991, Redstone Arsenal, Huntsville, AL[4]

NTI-5: The fifth NTI was a simulation of a challenge inspection at a sensitive Department of Energy (DOE) facility - August 1991

NTI-6: Routine inspection (commercial chemical industry) - June 1992, Hoechst Celanese Corp., Coventry, R.I.[5]

B. On-Site Inspections.

1. Baseline Verification Systems. The U.S. has conducted an iterative series of field tests and international equipment market surveys[33, 37, 40, 44, 45] to develop a baseline system of inspection procedures and available equipment for the verification aims identified from the CWC. Our initial analysis grouped the CWC's verification aims into scenarios which are listed in Table 1, page 5. Baseline surveys were conducted to evaluate a range of verification concepts for each scenario.[14, 15, 16, 17, 22] A further series of Equipment Field Trials and System Field Demonstrations were conducted to evaluate equipment and demonstrate integrated verification systems.[19, 25, 30, 31, 38, 39 70] In addition, directed exercises were conducted to test methods and evaluate a facility's ability to demonstrate compliance. The field test results are being translated into inspector guides[29, 41] and inspector training courses addressing detailed procedures for CWC on-site inspections.

2. *Sample handling and analysis.* Methods for sampling and on-site analysis are being developed for each inspection scenario.[24, 28, 35, 42, 43, 47, 51, 74] Requirements and specifications for international laboratories to support the CWC were developed.[26, 27, 31] The requirements for a CWC standards program were identified and selected chemical standards obtained.[21] A portable PC spectral properties data base is being developed. U.S. laboratories participated in international round robin tests,[53] joint field exercises with the United Kingdom, National Trial Inspections and directed exercises. A secure transport container adapted from International Atomic Energy Association (IAEA) standards was designed and tested for survival under extreme accident conditions including a 30 minute engulfing fuel fire.[23]

3. Database Management. Development of a prototype information management system for potential use by the International Organization is in progress. .System requirements, data handling and processing functional descriptions and data formats are complete.[66]

4. CW Signatures and Product Emission Study. Signatures associated with non-compliance scenarios are being analyzed.[11, 12] Models for air transport of CW associated chemicals to site perimeters were developed and physical parameters required by the model are being measured for model compounds. Research in remote spectroscopic detection of chemical agent precursors is also being pursued.

5. Legal/Constitutional Issues. Legal, constitutional and regulatory issues affecting the U.S. which could arise from the provisions of the CWC were identified.[10, 69]

6. Costing Analysis. Resource considerations for the International Inspectorate to implement the CWC on a world-wide basis were identified.

7. Implications of Inactivation and Destruction of CW Production Facilities. Alternatives for inactivating CW production facilities were delineated. Methods of decontamination, dismantling and destruction of these facilities are being investigated.[34]

8. Integrated Inspector Training Program. Inspector training requirements were identified and a training program for inspectors drafted.[8] Detailed training courses are being outlined and assembled.

9. Implications of the UN Special Commission on Iraq for the CWC. Lessons learned from the UN Special Commission to Iraq were documented.

C. Technology Development Programs.

1. Nondestructive Evaluation (NDE).

U.S. research programs in nondestructive evaluation technology include both acoustic and neutron methods.[20, 52, 55, 56, 63, 65, 74] The aim of the research is to develop field-portable instrumentation that can be used to evaluate munitions in their normal storage configuration as well as in the field. The various technologies described below are complementary to each other, as no single technology applies to all munition configurations or inspection objectives. The basic capability of each of these technologies was established in tests on a limited set of U.S. chemical weapons at the Tooele Army Depot in early 1991.[55] More extensive tests to obtain statistical data on the ability to distinguish conventional from chemical munitions in mid-1992 demonstrated the utility of these methods.

a. Ultrasonic Pulse Echo distinguishes liquid-filled containers from those filled with solid or powder and provides information about the physical properties of the fill. Tests on chemical weapons showed that this method can accurately determine both the presence of liquid and the level of liquid fill in a munition or container. Differentiation between different chemical fills based on differences in viscosity and density was also possible. A portable field prototype is available for use. Only a few minutes are required for set-up and measurement also requires only a few minutes.

b. Acoustic Resonance provides a unique signature for objects such as chemical agent containers and munitions. When an object is excited with a broad band acoustic signal it responds with a resonant acoustic signature that is a function of its size, shape, and physical properties. Frequency shifts in the spectrum give information about differences in level and density of the fill. A portable field prototype in which the acoustic excitation is directly coupled into the container wall has been developed and tested successfully. Research is ongoing on remote excitation and measurement. Only a few minutes are required for set-up and measurement requires only a few seconds per item.

Both of the acoustic systems are easy to use in the field. They utilize lightweight, portable, battery powered instruments with no major safety or support needs.

c. The neutron activation method identifies the elemental contents of an object by irradiating it with neutrons and simultaneously detecting emitted gamma rays which are characteristic of the elements in the object. The type of agent fill is deduced from those elements which are detected in combination with those which are not. The prototype system is compact and portable, providing the ability to interrogate munitions in their normal storage conditions. Approximately five minutes are required for set up. Detection times of approximately 10 to 30 minutes are required.

2. Chemical Detection and Analysis.

a. Research into degradation pathways of CW agents is being pursued to determine whether data from chemical analysis can indicate uniquely whether and when agent was present in materials such as soil and concrete.[47, 58]

b. A briefcase-sized GC/MS is being developed and a prototype unit was assembled to support on-site sample analysis.

c. Exercises have shown that routine sampling and analysis could lead to losses of sensitive proprietary and national security information. Methods to preclude such losses are being developed.

d. A microchip gas chromatograph to support rapid on-site detection and analysis of chemical agents is being developed. Signature processing and algorithm development is underway.

e. A toxin detector is being developed to fill a technology gap for rapid and sensitive analysis for toxins as these are included in the list of Schedule 1 chemicals covered by the CWC.

f. A generic detector to support team protection against an array of toxic agents is being developed by adapting an Army Chemical-Biological MS to this application.

3. Seals. A shrink-wrap seal has been developed for sealing complex geometrical configurations such as valves and munition filling heads at inactivated CW production facilities. The seal consists of polyvinylidene chloride (saran wrap) with a clear fluorescent coating and black ink patterns. Other materials are being investigated. The random shrinkage of the overlapping layers with different inked patterns produces a unique fingerprint which is photographed for comparison during later inspections. Field application kits have been developed and tested. An archival report is being prepared and is due out in November 1992.

II. SUGGESTED VERIFICATION ACTIVITIES, PERSONNEL AND EQUIPMENT AND IDENTIFIED CAPABILITY GAPS

Although the Chemical Weapons Convention is explicit about the aims of inspections, establishes general rules for inspections, and gives inspectors certain rights, it assigns resolution of detailed inspection activities to the Preparatory Commission. Recognizing the importance of gaining practical experience in preparation for inspections under the Chemical Weapons Convention, the United States conducted a series of National Trial Inspections and field tests to formulate, test, and refine inspection procedures and equipment and to identify capability gaps. Complementing these activities, research and development programs were undertaken to investigate new verification methods and technologies. Recommended inspection activities and personnel along with identified capability gaps resulting from this experimental effort are summarized in Section II.A for each of the eleven types of inspections mandated by the Chemical Weapons Convention listed in Table 1. Suggested equipment to perform these activities is included in Section II.B.

Table 1
Inspection Scenarios

I.	**Destruction of Chemical Weapons and Production Facilities**	
	Scenario 1.	Chemical Weapons Declarations and Storage Facilities
	Scenario 2.	Movement of Stocks to Destruction
	Scenario 3.	Destruction of Chemical Weapons
	Scenario 4.	Production Facility Declaration and Closure
	Scenario 5.	Destruction of Production Facility
II.	**Activities Not Prohibited**	
	Scenario 6.	Schedule 1 Chemicals and Facilities
	Scenario 7.	Schedule 2 Chemicals and Facilities
	Scenario 8.	Schedule 3 Chemicals and Facilities and Other Chemical Production Facilities
III.	**Fact Finding**	
	Scenario 9.	Investigation of Alleged Use
	Scenario 10.	Challenge Inspections
IV.	**Facility Conversion**	
	Scenario 11.	Conversion of CW Production Facilities

A. SUGGESTED INSPECTION ACTIVITIES AND PERSONNEL

1. SCENARIO 1: CHEMICAL WEAPONS DECLARATIONS AND STORAGE FACILITIES

a. Declarations

A detailed inventory of each CW storage facility must be provided at the time of inspection, including for each storage location or building.

- Number and type of each specific chemical weapon
- Nominal weight of chemical fill per item

b. Inspection Aims

The purpose of on-site inspection of declared CW storage facilities is to:

- Confirm the accuracy of stockpile declaration
- Ensure no undetected removal of items

c. Inspection Activities

Initial Inspection. At the initial inspection, it is suggested that inspectors perform an item-by-item inventory of all declared stocks and compare it to the declarations. Where the items are grouped in many identical stacks or pallets, it appears sufficient to count stacks making sure that each stack is full and noting those which are not. A randomly selected, statistically significant number of items should be measured and weighed and compared to the declaration. For containerized items, a small statistically significant number of containers should be opened and the identity of the item inside checked. To confirm the identity of the chemical agent fill, tamper-indicating tags should be affixed to a small number of randomly selected munitions, devices and containers to signal that the item has been selected for sampling and analysis of the chemical contents. Sampling will be accomplished at the storage site or destruction site as soon as practical, but no later than at the time of destruction. The results of the sample analysis would then be compared to the declared contents of the tagged item.

The application of non-destructive evaluation (NDE) equipment currently nearing commercialization would greatly facilitate CW stockpile inspection. An ultrasound pulse-echo unit could interrogate *in situ* the agent fill level in storage containers. To confirm that munitions are chemical and not conventional, a combination of NDE techniques, such as ultrasound pulse echo, acoustic resonance, or neutron activation could be used to interrogate *in situ* a randomly selected item. The advantage of this approach is that item fill can be investigated at the time of the stockpile inspection rather than waiting until chemical sampling and analysis can be performed prior to destruction. However, definitive confirmation of agent fill still requires sampling and analysis.

At the beginning of the inspection, the need to monitor site security should be determined by the inspection team. If deemed necessary, the inspectors should seal unused gates and periodically or continuously monitor remaining entry-exit points. The facility location should also be confirmed. As the inspection progresses, each bunker and building should be sealed after being inventoried to assure that stocks are not moved during the course of the inspection. Such seals will be removed at the end of the inspection. During the inspection any discrepancy with the detailed inventory shall be noted and, if possible, resolved on-site. The inspectors' inventory of each bunker, building or location are then summed and compared to the site declaration.

The intent of sampling and analysis of declared CW items is to provide assurance that the inventory is and remains as declared. Based on tactical analysis, confidence in the stockpile content can be acquired by randomly selecting a relatively small number of items for analysis[a]. This same rationale is applicable to the opening of boxed munitions to check for content. Because of the time and labor required to isolate and unpack CW munitions, and to sample CW items, the checking of only a small statistical number is recommended. When available, the *in situ* application of NDE will support the interrogation of greater numbers of items with an enhancement of statistical confidence. To conserve effort, the same items can be utilized for physical measurements, NDE or tagged for later analysis.

Subsequent Inspections. At subsequent inspections, inspectors should visually inspect all buildings and areas at the storage facility and then proceed as during the initial inspection except inspectors could perform either 100% or a partial inventory. A partial inventory should cover a statistically significant number of declared items. Structures to be inventoried should be sealed before and after the inventory. As in the initial inspection, a small statistically significant number of containers should be opened, physical measurements made, and NDE applied. Results of the inventory should be compared to the detailed inventory provided to the inspectors at the time of inspection and to shipment records maintained by authorities in charge of storage facility. In particular, inspectors should check that any change in stockpile inventory between the prior and current inspection are accounted for by the shipment records. Previously tagged munitions should be identified and inspected. NDE could be used to see if the content of these items has changed between inspections. Seals should be removed at the end of the inspection.

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[a] When the sampled items are randomly selected from a large number of items the following statistics apply:

$P_D = 1 - (1-Pc)^N$

When

P_D = Probably of detecting defect in sample population

P_C = Probability of counterfeit item in general population

N = Number of items sampled

For example, if an inspection team desired a 90% probability of detection for counterfeit units (P_D = .9) and estimated that as much as 10% of the stockpile could be counterfeit (P_C = .1), N would equal 22 (rounded up from 21.85). For this case, if 22 items were randomly selected and sampled, and each was found to comply with the declaration, then the inspectors would have a 90% confidence that the declaration was at least 90% accurate. If the inspectors desired a 90% confidence that the declaration was at least 95% accurate, then they would have to select and sample 45 items and find that each item complied with the declaration.

d. Inspection Team

Manpower: Inspection manpower requirements will depend on stockpile size and time available. A large site the size of the U.S. Tooele Army Depot, Tooele, Utah may require a 15 person team five to eight days for an initial inspection with use of NDE. A re-inventory inspection would require proportionately less depending on what percent of the stockpile was checked.

Team Composition: It is suggested that each inspection team consist of a team leader, senior linguist and a sufficient number of two person sub-teams to inventory the particular site. Each sub-team could consist of a chemical weapons expert and a linguist with knowledge of CW technical language. Additional sample and analysis specialists would be required if this activity occurs at the storage site.

e. Capability Gaps

Non-Destructive Evaluation (NDE) methods are currently being developed by the U.S., UK, Germany and France. These methods can interrogate an item using neutrons or ultrasound without opening the item. The agent is not positively identified by these but properties strongly indicative of the particular agent are measured. Commercialization of one or more NDE is expected within one-two years.

A highly reliable and portable monitor for low levels of agent which can be carried on-site by the inspection team is needed for situations where the host cannot guarantee inspector safety in a potentially contaminated environment.

No method currently exists for on-site measurement of toxic threshold levels of Lewisite vapor. Without such a capability, inspectors could not safely enter a Lewisite storage structure except in a fully encapsulated suit with Self Contained Breathing Apparatus.

A high security tag and reader system for monitoring the items selected for later sampling is needed.

References: The U.S. conducted a series of four field trial exercises at Tooele Army Depot to evaluate the recommended procedures and equipment, including NDE.[14, 19, 31, 55] It is the largest U.S. CW stockpile site and has over one million chemical munitions and bulk containers representing every munition type and storage configuration in the U.S. inventory.

2. SCENARIO 2: MOVEMENT OF DECLARED CW STOCKS TO DESTRUCTION

a. Declarations

The inspected State Party shall notify in writing the inspection team leader at a chemical weapons destruction facility not less than four hours prior to the departure of each shipment of chemical weapons from a storage facility to that destruction facility. The notification shall include:

- Specific types and quantities of CW shipped
- Whether items tagged for sampling are being moved

b. **Inspection Aims**

The purpose of this inspection is to provide assurance that items which leave the stockpile arrive at the destruction site(s).

c. **Inspection Activities**

It is anticipated that destruction site inspectors will make a complete inventory of all arriving shipments of CW and compare to the information contained in the written notifications. During the periodic re-inspection at storage facilities, inspectors should confirm current inventories and compare with shipment records. It is then necessary to correlate these two activities, for example, a 200 munition decrease at the storage facility should correspond to arrival of 200 munitions at the destruction facility.

d. **Inspection Team**

Movement inspections can be done by inspectors reviewing inventory records at periodic re-inspections of the stockpile site and by the permanent on-site inspectors at the destruction facility. Therefore, no additional manpower is expected.

e. **Capability Gaps** - None.

References: Concepts for on-site movement verification were tested at the same field trial exercises that were conducted for Scenario 1.[14, 19, 31]

3. SCENARIO 3: DESTRUCTION OF CHEMICAL WEAPONS

a. **Declarations**

For each CW destruction facility a State Party will provide detailed facility information, including:

- Drawings of facility, processes, piping and instrumentation
- Technical descriptions of destruction process, equipment, and operating conditions
- Measures to facilitate inspections
- Temporary storage areas

b. **Inspection Aims**

The purpose of on-site inspection of CW destruction is to:

- Verify capability of the destruction facility to destroy CW stocks
- Verify arrival of CW stocks at destruction facility
- Confirm identity and quantity of CW stocks to be destroyed
- Provide assurance that no CW stocks are diverted
- Confirm that CW stocks have been destroyed

c. Inspection Activities

Inspection procedures should be tailored to each destruction facility being inspected. The development of the specific verification procedures will begin with receipt of the detailed facility design information, and will be concluded with the Facility Agreement and the Destruction Facility Inspection Plan. The permanent on-site presence of inspectors at CW destruction facilities will verify the destruction of chemical weapons.

Prior to the start of destruction operations, a pre-visit engineering review of the facility data package followed by a site visit should be conducted by key members of the inspection team to verify capability of the destruction facility to destroy CW stocks. Design and installation of a process monitoring system incorporating a combination of host and inspector equipment is required to monitor destruction process operations. The facility piping system should be inspected. Limited ability to inspect piping below grade and within walls increases the difficulty in detecting diversion of CW materials within the piping system, and adds to process monitoring system complexity and cost. An on-site analytical laboratory should be established to support inspection operations.

During the destruction phase of operations, each shipment of CW should be verified when received at the destruction site storage facility using procedures analogous to inspecting a CW storage facility. To verify the quantity of CW stocks to be destroyed, each munition or container should be inventoried through a 100% stack count of items in the unpack area immediately prior to destruction. Visual inspection, physical measurement and sampling and analysis of tagged items and others selected at random should occur to verify item identity and content. When available, NDE could assist with confirming munition fill.

The actual destruction of the items should be confirmed by a combination of instrument monitoring in the control room, plant walk-throughs and closed circuit TV. The inspectors can estimate the quantity of agent downloaded and destroyed using process monitoring equipment installed by the site incorporating tamper resistant, and data authentication features as required.

To verify the identity and non-diversion of agent being destroyed, samples should be collected by the host as directed and observed by the inspectors. These samples should be analyzed by the inspectors in the on-site analytical laboratory. Sample chain-of-custody procedures need to be established for this operation. Ultrasound or neutron activation NDE technology may also have application to screen a number of items for similarity before selecting those for sampling and chemical analysis. The development of in-line analytical instrumentation such as on fourier-transform infrared spectrometer (FTIR) would be very useful, as it would obviate the need for contact with neat agent and streamline the analytical process for confirming identity.

Agent flow should be monitored along process lines if they are not visually accessible utilizing tamper-resistent, data authenticated flow monitors connected to the control room.

The byproducts of the destruction process should periodically be analyzed if the destruction process involves chemical conversion. To verify destruction of the metallic parts of munitions, containers, and devices, inspectors should periodically observe their mutilation and the end products of the destruction process.

Inspectors should periodically walk through the entire facility to verify that all activities are proceeding normally.

d. Inspection Team

Manpower and Team Composition: Manpower requirements will depend on the scale and complexity of the destruction operation and on the degree to which operations are continually monitored. The twelve-month preparatory period prior to the start of destruction verification would involve approximately 15 members of the inspection team to conduct engineering reviews, and plan and monitor installation of process monitors and the analytical laboratory. The following tabulation shows the range in numbers of inspectors suggested to maintain a continuous presence in the control room, process areas and unpack areas, versus the total number suggested to periodically-check these areas several times a shift. In both cases inspections are conducted three shifts per day, eight hours per shift, seven days per week.

Continuous Presence	Periodically Check	Position	Principal Duty
1	1	Team Leader	Overall Team Leadership
3	2	Deputy Team Leaders	Supervise Operating Shifts
4	4	Control Room Observers	Monitor Control Room
4		Process Observers	Monitor Process Areas
1	1	Analytical Chemist	Operate On-Site Lab
1	1	Laboratory Technician	Support On-Site Lab
1		Instrument/Data Technician	Support On-Site Lab
3	3	Munitions Expert	Unpack Area/Inventory
15	8	Linguists	Assist Technical Inspectors
2	1	Medical Technicians	Team Medical Support
1	1	Administrative Clerk	Administrative Support
36 Inspectors	*22 Inspectors*		

It is suggested that Deputy Team Leaders have managerial and operating experience in chemical plant operations. Control Room Observers should be a mix of the following disciplines: chemical engineering, mechanical engineering, instrument engineering, and control room operations. The Process Observers should be a mix of the following disciplines: chemical process engineering, mechanical engineering, synthetic organic chemistry, and plant operations.

e. Capability Gaps

Further testing of chemical process monitoring instruments such as FTIR would be helpful. These types of instruments have the potential to reduce significantly the frequency of sample collection and analysis.

Engineering and demonstration of a facility specific Data Authentication Systems will be needed. This system may be applicable to the use of existing host instrumentation in order to lower cost and intrusiveness.

References: The findings presented above are based upon a documentation review of the U.S. full-scale destruction facility (Johnston Atoll Chemical Agent Destruction System), and one field trial inspection exercise at the U.S. pilot plant facility (U.S. Army Chemical Agent Munitions Disposal System Activity, Tooele Army Depot) where destruction processes are evaluated.[22, 70]

4. SCENARIO 4: CW PRODUCTION FACILITY DECLARATION AND CLOSURE

a. Declarations

Declarations for chemical weapons production facilities will include:

- Measures taken to inactivate the facility
- Detailed inventory of buildings and specialized equipment

b. Inspection Aims

The purpose of on-site inspections of declared CW productions facilities is to:

- Confirm facility inactivation
- Confirm inventory of buildings and specialized equipment
- Ensure no undetected resumption of production
- Ensure no undetected removal of items

c. Inspection Activities

During the initial inspection, it is suggested that inspectors confirm the accuracy of the facility declaration by inventorying key pieces of specialized process equipment, and by visually inspecting the plant to document and photograph its condition and inactive status. The inspectors will review and determine the adequacy of the site's closure plan. Inspectors will then plan for monitoring of the facility with on-site equipment, tags and seals, utilizing the closure plan agreed upon by the State Party and the Inspectorate. Key items of equipment should be tagged so their subsequent destruction can be observed by inspectors. Key items should include the specialized equipment critical to the production process such as reactors and distillation columns. The inspectors should place and photograph tamper-indicating seals (ex. fiber-optic and shrink wrap seals) at critical points such as on valves in their inoperative position and on blind flanges.

During subsequent inspections, the inspectors may place and photograph additional tamper-indicating seals as they determine necessary. For some facilities, particularly those in a high state of readiness, activity-indicating monitors such as pressure, temperature, and flow sensors could also be placed at relevant positions in the process. Inspectors should periodically visually inspect the facility, inventory key process equipment, examine tags, seals and any process monitoring equipment to ensure that no resumption of production nor removal of declared items has occurred. They should systematically remove, inspect, and replace randomly chosen seals, both for maintenance purposes and to subject the seal to more careful examination for possible tampering. The frequency of re-inspections should be guided by facility condition and ease of restart.

d. Inspection Team

<u>Manpower</u>: It is expected that each initial and periodic inspection will require 6-15 inspectors on-site for a maximum of 5 days depending on the size and complexity of the site. For a large site such as U.S. Army's Pine Bluff Arsenal the suggested team size is 15 inspectors working for a period of 5 days.

Team Composition: It is suggested that each inspection team consist of a team leader, senior linguist and 1 to 3 sub-team "modules" based on size and complexity of site. Each subteam may include 3-4 trained inspectors to include a technical expert in chemical processes, a plant/construction engineer, a linguist with knowledge of CW technical language and a technician when required. Field work has shown the criticality of having process engineers familiar with CW production on the inspection team for this scenario.

e. Capability Gaps

A simple versatile automated tags and inventory system would greatly facilitate maintaining an accurate inventory of declared equipment.

A portable, reliable NDE system for determining liquid fill levels would be useful to verify declared presence (or absence) of liquids in process vessels. The ultrasound pulse-echo system would appear to fulfill the need. The unit is near commercialization.

Shrink wrap seals are recommended for sealing large or bulky items and complex geometrical shapes such as munition filling heads, valves and blind flanges. Development is complete, test kits are available and the seal is ready for commercialization.

References: An iterative series of three field tests were conducted at the GB Production Facility at Rocky Mountain Arsenal, Colorado, and a final field test was conducted at the Integrated Binary Production Facility at Pine Bluff Arsenal, Arkansas.[15, 25, 38] The GB facility is old and in a low state of readiness, whereas the binary facility is modern and in excellent condition.

5. SCENARIO 5: DESTRUCTION OF CW PRODUCTION FACILITY

a. Declarations

A State Party must provide a detailed plan for destruction of facilities and inventoried items, including proposed measures for verification.

b. Inspection Aims

The purpose of on-site inspection of the destruction of CW production facilities is to:

- Confirm destruction of declared equipment
- Confirm destruction of buildings

c. Inspection Activities

It is expected that inspectors would have tagged key pieces of specialized equipment during the initial inspection of the closed production facility for tracking during the destruction phase. Periodic inspections during the destruction phase are recommended to check the key items of equipment visually, check the integrity of security seals and observe the destruction process. Items of key equipment should be inventoried prior to destruction.

Periodically inspectors should observe the destruction of buildings. A photographic record should be maintained.

d. **Inspection Team**

The same inspection team that performs periodic inspection for facility closure could perform these functions.

e. **Capabili·;· Gaps**

A simple versatile automated tags and inventory system would greatly facilitate maintaining an accurate inventory of declared equipment.

A portable, reliable NDE system for determining liquid fill levels would be useful to verify declared presence (or absence) of liquids in process vessels. The ultrasound pulse-echo system would appear to fulfill the need. The unit is near commercialization.

Shrink wrap seals are recommended for sealing large or bulky items and complex geometrical shapes such as munition filling heads, valves and blind flanges. Development is complete, test kits are available and the seal is ready for commercialization.

References: Section 4 provides a listing of the field exercises that were conducted for Scenarios 4 and 5. Field tests for these two scenarios were conducted in conjunction with one another due to the inter-relationship of the declaration, closure and destruction aspects of CW production facilities.

6. SCENARIO 6: PERMITTED SCHEDULE 1 CHEMICALS AND FACILITIES

a. **Declarations**

For each facility involved in permitted production of Schedule 1 chemicals, i.e., Single Small Scale Facilities (SSSF) and Other Schedule 1 Facilities, a State Party must provide:

- Detailed technical description of the facility
- Detailed annual declaration of chemicals produced, acquired, consumed or stored

b. **Inspection Aims**

The following inspection aims apply to the different types of allowed Schedule 1 production facilities:

Single Small Scale Facility

- Verify information provided in declaration, including limits on reaction vessels.
- Verify that the quantities of Schedule 1 chemicals produced are accurately declared and, in particular, that their aggregate amount does not exceed one metric tonne.

100g-10Kg Per Year Facilities

- Verify that the facility is not used to produce any chemical listed in Schedule 1 except for the declared chemicals;
- Verify that the quantities of the chemicals listed in Schedule 1 produced, processed or consumed are correctly declared and consistent with needs for the declared purpose;
- Verify that the chemicals listed in Schedule 1 are not diverted or used for other purposes.

c. Inspection Activities

At the initial inspection of SSSF, it is suggested that inspectors review production, storage and shipment records and compare with declarations. They should visually inspect processes and equipment, and measure reactor volumes to check for conformity with requirements. Stocks should be inventoried and compared with declarations. Plans for future inspections and a Facility Agreement should be concluded.

At subsequent SSSF inspections the process equipment would be visually inspected for conformity with declaration. Production records would be reviewed and stocks inventoried. If inspectors suspect undeclared production of Schedule 1 chemicals, then they should request that samples be taken and then analyzed on-site with screening test kits to verify absence of undeclared Schedule 1 chemicals. If concerns are not allayed, samples should be sent to a designated off-site laboratory for analysis. Inspectors should also interview employees.

Routine inspections at 100g-10Kg per year facilities should be limited to visual observation and review of records for conformity with declarations.

d. Inspection Team

Manpower: It was estimated that five inspection personnel could complete an Initial SSSF Inspection in two eight-hour days and that a periodic inspection performed by the same inspection team would require four days to complete.

Team Composition: It is suggested that the team consist of a Team Leader, two chemical engineers, a detection/analytical expert and a translator.

e. Capability Gaps

A reliable instrument to determine liquid levels in storage containers is needed for measuring quantity of liquid. An ultrasound pulse-echo device nearing commercialization should fulfill this need.

A screening "go/no-go" detector kit for declared Schedule 1 chemicals is urgently needed to achieve a more definitive confirmation of the identity of declared chemicals and the absence of undeclared chemicals than is currently provided by available kits (ex. Draeger tubes).

A safe, secure sample containment and transport container is needed to ship samples by air to designated laboratories.

References: Two exercises were conducted at simulated SSSFs since currently no SSSF exists in the U.S.[16, 39] The tests were conducted at Lawrence Livermore National Laboratory's Site 300 High Explosives Complex and at two U.S. Army Edgewood Research, Development and Engineering Center's (ERDEC) facilities.

7. SCENARIO 7: SCHEDULE 2 CHEMICALS AND FACILITIES

a. Declarations

For each Schedule 2 plant, declarations must include:

- Main activities, including whether it produces, processes, or consumes the Schedule 2 chemical
- Production capacity for declared Schedule 2 chemicals
- For Schedule 2 chemicals, the total amount produced, processed or consumed in past year and during any of the previous 3 years or anticipated for next year

b. Inspection Aims

The purpose of on-site inspections of Schedule 2 facilities is to confirm:

- Absence of any Schedule 1 chemical, especially its production
- Consistency with declarations of levels of production, processing or consumption of Schedule 2 chemicals
- Non-diversion of Schedule 2 chemicals for activities prohibited under the Convention

c. Inspection Activities

At the initial inspection, it is suggested that inspectors review and compare with declarations engineering drawings and records associated with declared activities including records of raw material usage, product shipment, processing and storage, and process records. They should visually inspect feedstock areas, processes and equipment, and waste treatment areas, to assure consistency with declaration. Inspectors should assess risk of the facility to the Convention based on factors such as potential to produce Schedule 1 chemicals. Stocks should be identified and inventoried. A Facility Agreement should be prepared during the initial inspection unless the inspected State Party and the inspection team agree that it is not needed. The facility agreement would govern the conduct of inspections to include frequency, intensity and detailed inspection procedures, consistent with the CWC.

At subsequent inspections at the Schedule 2 plant, activities should be the same as at the initial inspection. Based on an engineering assessment of the plant, inspectors should request that samples (including process and environmental samples from critical areas) be taken and analyzed in their presence to verify absence of undeclared Schedule 1 chemicals. Interviews with employees should also be permitted. If questions arise about the identity of any stored or produced chemicals, inspectors should request that samples be taken and analyze them on-site to check for absence of undeclared Schedule 1, 2 or 3 chemicals with a portable GC-MS. Special procedures, software, or equipment should be used to ensure that only scheduled chemicals are identified, and to protect against the loss of confidential business information. If anomalies cannot be resolved, samples should be sent off-site to a designated laboratory for analysis.

d. Inspection Team

<u>Manpower</u>: It is expected that a typical Schedule 2 plant of one production unit would require nine inspectors approximately 3 days to complete an inspection. The size of the team may vary for large complex plants or small simple plants. Initial inspections involving Facility Agreement negotiations will take more time.

Team Composition: It is suggested that the team consist of a Team Leader, four chemical engineers, an analytical chemist and a detection expert and two translators to accompany the process and records review sub-teams.

e. Capability Gaps

A "go/no-go" detector/test kit with a high sensitivity and a low false alarm rate is urgently needed for Schedule 1 chemicals. Because only non-specific tests are currently used to screen for Schedule 1 chemicals, false positive responses may be caused by non-Scheduled chemicals having some characteristics in common with a Schedule 1 compound.

The wide variety of compounds possibly encountered in a commercial production facility and the need to protect confidential business information in industrial plants makes it necessary to develop a Mass Spectral Database of Schedule 1 compounds, their decomposition products and unique precursors for the GC/MS. With such a tool the instrument would respond only to the compounds of interest and protect the identity of commercially important materials. Such a database is under development.

A highly portable and automated GC-MS is needed to facilitate Schedule 2 inspections.

A safe, secure sample containment and transport container is needed to ship samples by air to designated laboratories.

References: *Inspection procedures were first investigated in two* National Trial Inspections at Akzo Chemicals, and Alcolac, Inc.[1, 2] Procedures were refined in three field exercises at DuPont Chambers Works.[17, 30, 71]

8. SCENARIO 8: SCHEDULE 3 CHEMICALS AND FACILITIES AND OTHER CHEMICAL PRODUCTION FACILITIES

a. Declarations

For each declared Schedule 3 plant site a State Party must provide:

- Number of plants producing specified chemicals
- Its Main activities of each plant producing specified chemicals
- For each declared Schedule 3 chemical the approximate amount produced in the past year and anticipated for next year

For each listed Other Chemical Production Facility, a State Party must provide for the plant site:

- Its main activities
- Approximate aggregate amount of production of specified chemicals in previous year
- Number of plants producing specified chemicals on that plant site

b. **Inspection Aims**

The purpose of on-site inspection of Schedule 3 and Other Chemical Production Facility is to confirm:

- Activities are consistent with declared information
- Absence of Schedule 1 chemicals, particularly their production

c. **Inspection Activities**

Inspections at these two types of facilities are expected to be essentially the same except that the inspected State must provide access to Schedule 3 plants but has the right to use managed access procedures at Other Chemical Production Facilities. Inspections of Other Chemical Production Facilities would start at the beginning of the fourth year after entry into force of the CWC unless the Conference of the States Parties decides otherwise. During the inspection the inspectors should visually inspect feedstock areas, processes and equipment, waste treatment areas, and product storage areas to assure consistency with declaration.

Inspectors should check for indications of Schedule 1 production and assess the capability of the plant to produce Schedule 1 chemicals.

If inspectors suspect undeclared production or storage of Schedule 1 chemicals or if the potential to produce these appears high, the inspectors should request that samples (including environmental or process samples from critical areas) be taken in their presence. The samples should be analyzed by the inspectors on-site using screening test kits to verify the absence of Schedule 1 chemicals and to protect against the loss of confidential business information. If anomalies cannot be resolved, samples should be sent to off-site designated laboratories for analysis. Interviews with employees should also be conducted to resolve anomalies.

d. **Inspection Team Requirements**

Manpower: It is anticipated that the inspection will require 4-10 inspectors, depending on plant size and complexity, and one day to complete. (The CWC limits the inspection to 24 hours)

Team Composition: A suggested team could consist of a Team Leader, a chemical/process engineer, a detection expert and a translator. This team could be expanded by adding two three-person sub-teams composed of a chemical/process engineer, a detection expert and translator to inspect various parts of a large facility simultaneously.

e. **Capability Gaps**

A "go/no-go" detector/test kit with a high sensitivity and a low false alarm rate is urgently needed for Schedule 1 chemicals. Because only non-specific tests are currently used to screen for Schedule 1 chemicals, false positive responses may be caused by non-Scheduled chemicals having some characteristics in common with a Schedule 1 compound.

A safe, secure sample containment and transport container is needed to ship samples by air to designated laboratories.

References: The procedures for inspecting Schedule 3 and Other Chemical Production Facilities were tested at DuPont Chambers Works[72] and during a National Trial Inspection at the Hoechst Celanese Corporation Plant.[73]

9. SCENARIO 9: INVESTIGATION OF ALLEGED USE

a. Request for Inspection

If a State Party believes that CW have been used on its territory or on that of another State Party, it may request a special investigation. The request should include:

- Location and characteristics of alleged use area
- Time of alleged use
- Types and characteristics of chemical weapons alleged to have been used
- Extent and biological effects of alleged use

b. Inspection Aims

The purpose of a special inspection is to determine facts relevant to the allegation of use.

c. Inspection Activities

The U.S. has not specifically investigated this scenario. The following suggested inspection activities are based on experience and understanding gained from experimental work on the other inspection scenarios. Additional investigations are required to test and refine these suggestions.

It is suggested that the inspection team physically examine victims and request victims' autopsy results in the case of fatalities. They should interview other persons in the affected area, local officials, military commanders and physicians.

Inspectors should visually inspect all areas affected by the alleged use of chemical weapons. They should also request access to hospitals, refugee camps and other locations they deem relevant to the investigation.

The inspection team should collect samples of chemicals from munitions and devices. They should also collect environmental samples (air, water, vegetation, etc.) and biomedical samples from human or animal sources (blood, urine, excreta, tissue, etc.).

Samples should be screened and analyzed on-site, if possible. They should also be sent off-site to accredited laboratories for confirmatory analysis.

Inspections of alleged use should be conducted as soon as possible after the incident because of the rapid degradation of chemical agents.

d. Inspection Team

Manpower: A suggested minimum manpower requirement would be a 6 member team taking 3-10 days to conduct interviews, travel (if possible) to the actual use areas and collect and analyze chemical samples.

Team Composition: The team could be comprised of a team leader, CW and conventional munitions expert, sampling and detection expert, physician and a translator.

e. Capability Gaps

A "go/no-go" detector kit for screening CW samples for positive identification is needed.

A highly portable and automated GC-MS is needed to reduce logistic burden and facilitate on-site sample analysis during these inspections.

A safe, secure sample containment and transport container is needed to ship samples by air tc designated laboratories.

References: None specific to this scenario.

10. SCENARIO 10: CHALLENGE INSPECTION

a. Request for Inspection

If a State Party is concerned that another State Party is not in compliance with the Convention it has the right to request a Challenge Inspection of any facility or location in the territory or in any other place under the jurisdiction or control of any other State Party. The request for a Challenge Inspection shall include:

- The State Party (or Host State) to be inspected
- The size and type of inspection site
- The specific compliance concern (undeclared CW storage or production)

The location of the challenged site will be revealed 12 hours prior to arrival of the inspection team at the point of entry.

b. Inspection Aims

The purpose of a Challenge Inspection is to determine facts relevant to the compliance concern.

c. Inspection Activities

Since many challenges would be at undeclared sites, the inspectors may be in an adversarial situation, and will not be assured of logistic support from the host. Therefore, they need to be as self sufficient as possible.

It is suggested that inspectors seek to close all but one or two entry and exit points and monitor those which remain open. They should request to search exiting vehicles on a random basis, or on the basis of suspicion, to check that chemicals or related equipment are not being removed from the site. If suspicious chemicals or equipment are discovered, inspectors should check for the presence of agent with monitoring devices and collect samples for on-site analysis. Inspectors should also periodically patrol the perimeter of the inspected site, use any relevant monitoring equipment, and take environmental samples (if deemed useful) for on-site analysis.

Inspectors should seek to visually inspect all buildings and, as needed, request photographic documentation. They should be prepared to collect and analyze samples on-site for scheduled compounds and to prepare samples for shipment to designated off-site laboratories. Analysis should be restricted to searches for Scheduled compounds, their decomposition products and unique precursors. Inspectors should also be prepared to temporarily seal buildings or areas to assure that nothing is removed while the inspected party shrouds or otherwise prepares a building for inspection. Inspectors should attempt to review facility records and compare with stated activities. They should seek to review safety procedures and employee health records, and interview employees.

The buildings and bunkers that are to be entered should be randomly selected if the size of the site precludes 100% inspection. Likewise, the selection of munitions and vessels for confirmation of being non-CW should be random. NDE may be used to screen selected items for type of fill. The ultimate responsibility to verify that a munition is not a CW must lie with the inspected party. Providing a sample to the inspection team for analysis is one approach, but the site may offer other ways to verify absence of CW.

d. Inspection Team

Manpower: The minimum manpower anticipated includes a five-person technical team, plus translators (three minimum), plus sufficient personnel to secure the site (at least six for the smallest known site, assuming three-person teams working twelve-hour shifts). At larger or more complex sites, the technical team could be supplemented by additional three-person units to survey different areas simultaneously. The duration of the inspection is not to exceed 84 hours.

Team Composition: The suggested inspection team would be comprised of a team leader, process engineers familiar with CW production processes, stockpile experts, a detection expert, analytical chemists (2), site security personnel (as needed), and translators.

The supplemental three-person units for the technical team may be composed of one process engineer (or stockpile expert), one detection expert and one translator.

e. Capability Gaps

A highly reliable, portable monitor for low levels of toxic agent which can be carried on-site by the inspection team is needed for situations where the host cannot guarantee inspector safety in a potentially contaminated environment.

The use of a Non-Destructive Evaluation (NDE) technique discussed under Scenario 1 could resolve the question of whether a munitions stockpile contains conventional or chemical rounds without opening any items and the question of what was in a storage tank or a reactor in a production facility.

A "go/no-go" detector kit for screening Schedule 1 compounds is urgently needed.

The wide variety of compounds possibly encountered in challenge situations and the need to protect confidential business information in industrial plants makes it necessary to develop a Mass Spectral Database of Schedule 1 compounds, their decomposition products and unique precursors for the GC/MS. With such a tool the instrument would respond only to the compounds of interest and protect the identity of commercially important materials. Such a database is under development.

A highly portable and automated GC-MS is needed to reduce logistic burden and facilitate challenge inspections.

A safe, secure sample containment and transport container is needed to ship samples by air to designated laboratories.

Reference: Challenge Inspection issues were addressed at field tests conducted at Tooele Army Depot[17] and DuPont Chambers Works[70] and at two National Trial Inspections (NTIs) conducted at the Monsanto Agricultural Company in Luling, LA.[3] and at Redstone Arsenal, Huntsville, AL.[4]

11. SCENARIO 11. CONVERSION OF CW PRODUCTION FACILITIES

a. Declarations

The request for conversion of a CW production facility to purposes not prohibited by the Convention must include:

- Detailed plan for conversion
- Details of proposed activities
- Proposals for verification measures

Among the conditions for conversion is that processes and equipment at the converted facility must be inconsistent with production of highly toxic chemicals, specifically Schedule 1 and 2 chemicals, unless explicitly agreed by the appropriate decision making body.

b. Inspection Aims

The purpose of inspections at facilities converted to activities not prohibited by the Convention will be to confirm that activities are consistent with declarations.

c. Inspection Activities

The U.S. has not specifically investigated this scenario. However, experience gained from verification experiments on Schedule 2 and other commercial facilities appears applicable to this scenario and forms the basis for the following suggestions. Additional investigations are needed to test and refine these suggestions.

It is suggested that inspectors initially visit the site and conduct a visual inspection to determine the accuracy of the information contained in the request. The State Party will propose verification measures and inspectors will develop an inspection plan tailored to the facility. During conversion of the facility inspectors should have unimpeded access to the production facility, and should tag key items of specialized equipment that will be destroyed. Inspectors should observe the destruction of these key items. Continuous on-site monitoring by inspectors may be required in certain cases.

After the conversion, continuous on-site presence of inspectors is not precluded. Otherwise, inspectors should visually inspect the entire production facility (on short notice, several times per year) to verify that processing, piping, safety procedures, and equipment are consistent with the declared purpose of the facility and that they are inconsistent with production, processing or consuming of Schedule 1 and 2 chemicals. This should include routine sampling and analysis of feed-stocks, product, and waste effluent streams to verify declared activities. Storage areas should be inspected as well. Inspectors should review detailed facility records and interview employees. Tamper-indicating, data-authenticated process monitoring equipment should be installed if inspectors desire. If inspectors suspect the presence of Schedule 1 or 2 chemicals, they should request samples be taken and analyzed to confirm the absence of these chemicals.

d. Inspection Team Requirements

Manpower: Manpower requirements will depend on the specific verification measures agreed to. A minimum team size of four people on-site for 1-3 days is envisioned during periodic inspections.

Team Composition: At a minimum, the team should consist of a team leader, process engineer, analytical chemist and a translator.

e. Capability Gaps

A "go/no-go" screening detector kit would facilitate screening for Schedule 1 and 2 chemicals to verify their absence while protecting confidential business information.

References: References on experiments to verify Schedule 1, 3 and Other Chemical Production Facilities apply here.[17, 30, 70, 72, 73]

B. SUGGESTED INSPECTION EQUIPMENT

A matrix of suggested inspection equipment for each inspection scenario is presented in Table 2. This listing is based on experience gained from the field tests and NTI previously referenced and market surveys and technical investigations cited in the reports listing. As such, Table 2 should be considered as a starting point in selecting inspection equipment and not as a final recommendation.

Commercial items of equipment are available for each of the items in Table 2 except for those listed under "Equipment Nearing Commercialization" and "Capability Gaps". The equipment listed as nearing commercialization will greatly assist in the conduct of CW inspections and is in the final stages of development or, in the case of a facility specific data authentication system, can be engineered using available technology. Of the items listed under Capability Gaps, the portable lower level agent monitor, in-process chemical analysis, automated inventory system and spectral data base Schedule 1, and highly portable and automated GS/MS, and safe transport container are currently being developed.

Equipment for Conversion of CW Production Facilities is expected to be similar to that for Schedule 2 facilities augmented with process monitoring equipment if required.

The requirement for spare parts will be important to the maintenance and operation of inspector equipment and a recommended list of spare parts should be developed. Exposure and safety standards need to be established and used as criteria for the final selection of safety equipment.

There is commonality of much equipment across the inspections scenarios which will allow for pre-packaging of standard equipment modules. Other specialized equipment should be assembled for the specific inspection.

TABLE 2
SUGGESTED INSPECTION EQUIPMENT BY SCENARIO

SUGGESTED EQUIPMENT	INSPECTION SCENARIO									
PORTABLE INSPECTION EQUIPMENT	1 CW STOCKPILE	2 CW MOVEMENT	3 CW DESTRUCTION	4 CW PRODUCTION FACILITY CLOSURE	5-CW PRODUCTION FACILITY DESTRUCTION	6 PERMITTED SCH. 1 PRODUCTION	7 SCHEDULE 2 FACILITIES	8 SCHEDULE 3 OTHER FACILITIES	9 ALLEGED USE	10 CHALLENGE INSPECTION
Global Positioning System	•			•					•	•
Load Cells & Readers	•		•							•
Fiber Optic Seals with Readers	•		•	•	•					•
Frangible Seals	•			•	•					•
Thermochromic Tape				•	•					
Rulers & Tape Measures	•		•	•	•	•	•		•	•
Miners Light	•			•	•					
Flashlights	•		•	•	•	•	•	•	•	•
Cameras, Polaroid, Film, Photo Labels, Close-Up Lens	•		•	•	•	•	•		•	•
Binoculars	•			•	•		•	•	•	•
Calipers	•		•							
X-Ray System (For Piping)			•							
Batteries	•		•	•	•	•	•	•	•	•
Inventory Control System				•	•					
Maps (Country, Region, Site)	•		•	•		•	•	•	•	•
Equipment Belt or Shoulder Bag	•		•	•	•	•	•	•	•	•
Multimeter w/Power Attachment				•						
Metal Stamp Kit & Engraving Tool				•	•					
Video Camcorder, 8mm				•	•	•				
Microcassette Recorder & Tapes (Optional)	•		•	•	•	•	•	•	•	•
Detector Kit (Draeger Tubes, Enzyme Tkts)	+					•	•	•	•	•
Portable GC/MS w/ Auxiliaries	+						•			•
Power Generator and Conditioner	+						•			•
Analytical Standards	+						•			•
Sample Collection & Preparation Equipment	+		•			•	•	•	•	•
Misc Chem Lab Items	+						•			•
CAM							•	•	•	•

(+) Required if samples are provided by the inspected party at the storage facility rather than at the destruction facility.

SUGGESTED EQUIPMENT	INSPECTION SCENARIO									
INSTALLED INSPECTION EQUIPMENT	1 CW STOCKPILE	2 CW MOVEMENT	3 CW DESTRUCTION	4 CW PRODUCTION FACILITY CLOSURE	5-CW PRODUCTION FACILITY DESTRUCTION	6 PERMITTED SCH. 1 PRODUCTION	7 SCHEDULE 2 FACILITIES	8 SCHEDULE 3 OTHER FACILITIES	9 ALLEGED USE	10 CHALLENGE INSPECTION
On-Site Analytical Laboratory - GC/MS With Autoinjector, Data System and Printer, Columns, Accessories, etc. - GC With Dual FPD, Support Equip - Spare Parts, Accessories, etc. - Chemical Sampling Equipment - Laboratory Glassware - Miscellaneous Lab Equipment - Chemical Standards, Test Mixes, Solvents, etc.			●							
Safety Monitoring: Ex. ACAMS Analyzer and Accessories			●							
Process Monitoring System - One or More Items, Press. Flow, Temp, Elec Sensors - Data Collection Nodes - Base Station - Activity Activated Camera - Cabling - Lock-Boxes			●	● (1)						
PROTECTIVE AND SAFETY EQUIPMENT										
Agent Protective Suits and Masks	●		●	●	●	●			●	●
Self Contained Breathing Apparatus	●		●							●
Cooling Vest			●							
Communication Set			●							
Protective Clothing (Safety Goggles, Shoes, Glasses, Hard Hat, Coveralls, Aprons, Gloves, Cold Weather Clothing)	●		●	●	●	●	●	●	●	●
Host Provided Safety Items							●	●		
Chemical Safety Monitors (Ex. MINICAM)	●		●							
Detector Kits (Draeger Detector Tubes, PH Paper, Starch Iodide Paper, M272 Water Kit, M8 Paper)				●	●	●			●	●
Flammability Monitor							●	●		●
Medical Supplies	●		●	●	●	●	●	●	●	●
ADMINISTRATIVE EQUIPMENT										
Calculators	●	●	●	●	●	●	●	●	●	●
Laptop Computer/Software/Printer	●	●	●	●	●	●	●	●	●	●
Datafax/Copier Machine (Optional)	●		●	●	●					●
Hand-Held Radios (Inter-Team)	●			●	●		●	●	●	●
Radio w/Satellite Link	●		●	●	●	●			●	●
Stationary Supplies/Forms	●	●	●	●	●	●	●	●	●	●
Maintenance/Tool Kits	●		●	●	●	●	●		●	●
Equipment Transport Containers	●			●	●	●	●	●	●	●

SUGGESTED EQUIPMENT	INSPECTION SCENARIO									
EQUIPMENT NEARING COMMERCIALIZATION	1 CW STOCKPILE	2 CW MOVEMENT	3 CW DESTRUCTION	4 CW PRODUCTION FACILITY CLOSURE	5-CW PRODUCTION FACILITY DESTRUCTION	6 PERMITTED SCH. 1 PRODUCTION	7 SCHEDULE 2 FACILITIES	8 SCHEDULE 3 OTHER FACILITIES	9 ALLEGED USE	10 CHALLENGE INSPECTION
Non-Destructive Evaluation										
- Ultra-Sound (Fill Analysis)	•								•	•
- Neutron (Element Analysis)	•								•	•
- Ultra-Sound (Fill Level)	•			•		•				•
Secure Sample Containment & Transport Eq.	•		•			•	•	•	•	•
Shrink Wrap Seals and Support Equipment				•						
Facility Specific Data Authentication System with Tamper Protection			•	•(1)						
CAPABILITY GAPS										
Go/No-Go Schedule 1 Detector Kit						•	•	•	•	•
Portable Low-Level Agent Monitor	•		•			•			•	•
Highly Portable & Automated GC/MS							•		•	•
Lewisite Safety Monitor	•		•							•
In-Process Chemical Analysis			•							
Automated Tagging and Inventory System				•	•					
Spectral Data-Base Schedule 1							•		•	•
Munition Tag System	•									

(1) The extent to which a process monitoring system will be utilized is site specific and depends on facility characteristics such as current status, condition and complexity. Telemetry of results to a central location is possible.

III. LISTING OF RELEVANT U.S. REPORTS

1. NTI-1: Chemical Industry Monitoring Experiment, First National Trial Inspection Report, May 1989; and CD/822, 22 June 1989.

2. NTI-2: Chemical Industry Monitoring Experiment, Report on the Second National Trial Inspection, August 1990; and CD/CW/WP.301, 27 June 1990.

3. NTI-3: Chemical Industry Challenge Experiment, Report on the Third National Trial Inspection, July 1991; and CD/1100, 14 August 1991.

4. NTI-4: Challenge Experiment at a Sensitive Government Facility, Report on the Fourth National Trial Inspection, November 1991; and CD/1107, 23 August 1991.

5. Draft Technical Report, Technical Ramifications of the Inclusion of Toxins in the CWC (Revised), USAMRIID, Apr 92

6. A Study of Detector Utility in the Chemical Weapons Convention, Battelle, 12 Nov 91.

7. Chemical Weapons Treaty Technologies Reference Collection Bibliography and Index, Battelle, Dec 91

8. DNA-TR-91-21, Examination of the Functions, Qualifications, and Training of Inspectors for the CWC, BDM Inc., Jun 92

9. DNA-TR-91-213, Analysis of the Interactions Between Treaties, BDM Inc., Apr 92.

10. DNA-TR-91-216, Harmonizing the Chemical Weapons Convention with the United States Constitution, BDM Inc., Apr 92

11. Chemical Weapons Convention (CWC) Signatures Analysis (Final Technical Report No. 1396), SPC Inc., Aug 91

12. Analysis of Signatures Associated with Noncompliance Scenarios (Final Technical Report No. 1407), SPC Inc., 31 Jan 92

13. Compliance Monitoring for the Chemical Weapons Convention, Preliminary Operational Concepts Report, CRDEC-CR-098, May 91

14. Compliance Monitoring for the Chemical Weapons Convention, Inspection Report: Tooele Army Depot Initial Walk Through, CW Stockpile: Scenario 1, CW Movement to Destruction: Scenario 2 EAI Report 85/91/012, Nov 90

15. Chemical Weapons (CW) Treaty Verification Technology Research and Development, Inspection Report, Rocky Mountain Arsenal Initial Walk Through, GB Production Facility Declarations and Closure: Scenario 4, Destruction: Scenario 5, EAI Report 85/91/013F, Feb 91

16. Chemical Weapons (CW) Treaty Verification Technology Research and Development, Baseline Survey Report: Simulated Single Small-Scale Facility Permitted Schedule 1 Chemicals: Scenario 6 EAI Report 85/91/014F, Feb 91

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